SDMS US EPA Region V

Imagery Insert Form

Document ID: 165256

Some images in this document may be illegible or unavailable in SDMS. Please see reason(s) indicated below:

[X] Illegible due to bad source documents. Image(s) in SDMS is equivalent to hard copy.

Specify Type of Document(s) / Comments:

TEXT ON SOME TABLES; TEXT RUNNING OFF THE BOTTOM OF A PAGE

[ ] Includes _____ COLOR or _____ RESOLUTION variations.
Unless otherwise noted, these pages are available in monochrome. The source document page(s) is more legible than the images. The original document is available for viewing at the Superfund Records Center.

Specify Type of Document(s) / Comments:

[ ] Confidential Business Information (CBI).
This document contains highly sensitive information. Due to confidentiality, materials with such information are not available in SDMS. You may contact the EPA Superfund Records Manager if you wish to view this document.

Specify Type of Document(s) / Comments:

[ ] Unscannable Material:
Oversized ____ or ____ Format.
Due to certain scanning equipment capability limitations, the document page(s) is not available in SDMS. The original document is available for viewing at the Superfund Records center.

Specify Type of Document(s) / Comments:

[ ] Document is available at the EPA Region 5 Records Center.

Specify Type of Document(s) / Comments:

Rev. 07/10/02

165256

000303

R-33-7-6-3

ADDENDUM

FEASIBILITY STUDY OF ALTERNATIVES

KALAMAZOO RIVER PCB PROJECT
KALAMAZOO AND ALLEGAN COUNTIES, MICHIGAN

STATE OF MICHIGAN CONTRACT NUMBER 1611

NUS PROJECT NUMBER 7339

JULY 1986

NUS CORPORATION

A Halliburton Company

NUS CORPORATION

Park West Two
Cliff Mine Road
Pittsburgh, PA 15275
412-788-1080

R-33-7-6-3

ADDENDUM

FEASIBILITY STUDY OF ALTERNATIVES

KALAMAZOO RIVER PCB PROJECT
KALAMAZOO AND ALLEGAN COUNTIES, MICHIGAN

STATE OF MICHIGAN CONTRACT NUMBER 1611

NUS PROJECT NUMBER 7339

JULY 1986

SUBMITTED FOR NUS BY:

Joseph G. Yeasted

JOSEPH G. YEASTED, Ph.D., P.E.
PROJECT MANAGER

APPROVED:

G. A. [illegible] FOR

GEORGE GARDNER
MANAGER
MICHIGAN REGIONAL OFFICE

CONTENTS

TABLES

The comments on the modeling study included both general and specific comments received from Varnum, Riddering, Schmidt, and Howe, the attorneys representing Allied Paper Corporation. A copy of these comments is attached as Appendix A. The response corresponding to the general and specific types of comments are presented in Sections 4.0 and 5.0, respectively.

2.0 EXCAVATION AND ONSITE DISPOSAL

Description

This alternative involves complete excavation of all contaminated sediments in Portage Creek, and subsequent disposal in a newly constructed disposal area on site. As in the other excavation alternatives, an excavation volume of 83,000 cubic yards is assumed. Temporary stream diversion installed prior to excavation would facilitate the excavation and would reduce material handling problems. When the excavation is complete, the excavated area would be backfilled to its original grade, and revegetated. A natural channel would, therefore, be reestablished to convey the Portage Creek flow.

Under this disposal option, the excavated sediments are disposed in an onsite disposal facility. Since many of the sediment samples from Portage Creek exhibited PCB concentrations greater than 50 ppm, the facility must comply with the requirements of a chemical waste landfill under the Toxic Substances Control Act (TSCA), as specified in 40 CFR, Part 761.75. A summary of the technical requirements is outlined below:

(1) Soils
- (i) 3 feet compacted clay liner
- (ii) Permeability $\leq 1 \times 10^{-7}$ cm/sec
- (iii) Percent passing 200 sieve >30
- (iv) Liquid limit >30
- (v) Plasticity index >15

(2) Synthetic Liner - only required to provide a permeability equivalent to (1) soils

(3) Hydrologic - bottom of landfill liner must be at least 50 feet above historical high water table.

(4) Flood Protection - if site is below 100-year floodwater elevation, diversion dikes must be provided to height 2 feet above 100-year flood. If site is above 100-year floodwater elevation, diversion dikes to divert 25-year, 24-hour storm must be provided.

(5) Topography - shall be located in an area of low to moderate relief.

(6) Monitoring
   - (i) Prior to commencing operations - groundwater and surface water samples
   - (ii) During disposal operations - surface water samples monthly
   - (iii) After final closure - surface water samples every 6 months
   - (iv) Quarterly - groundwater sampling at a minimum of 3 wells for PCBs, pH, conductivity, and chlorinated organics

(7) Leachate Collection - simple, compound, or suction systems required, and shall be monitored monthly

(8) Operational Requirements

(9) Supporting Facilities
   - (i) 6-foot chain link fence
   - (ii) Roads to support operation/maintenance

Written approval of a chemical waste landfill from EPA's Regional Administrator is required. Approval is based on a written report submitted by the owner/operator.

<u>Feasibility</u>

The proposed location of the onsite disposal facility is the area of the former waste disposal ponds on the Allied Paper Mill property. This location would be ideal in terms of its proximity to Bryant Mill Ponds; however, since it is in such a low-lying area, it would not meet the TSCA chemical waste landfill requirement that the bottom liner of the landfill be at least 50 feet above the water table. Therefore, it may be difficult to obtain a permit to construct such a facility. In addition, flood protection (in the form of dikes) would be required if the landfill is located within the 100-year floodplain. If a waiver for the water table requirement cannot be obtained from the EPA Regional Administrator, an alternative location would have to be determined. Since the area around the site is heavily populated, an alternative location in the immediate vicinity of the site is not likely to be found. Costs to transport the sediment to the alternative location would add significantly to the overall cost of the project.

Other than the aforementioned constraints, which may make it difficult to permit the proposed facility, there does not appear to be any extraordinary excavation or construction problems associated with implementation of this alternative.

Time and Cost

Assuming that the Allied disposal pond area is approved for the site of the new disposal facility, the time required for completion of excavation and construction of the landfill is estimated to be a minimum of 2 years. An additional 1-2 years would be required for the design and permitting of the landfill.

The major capital costs would be related to construction of the new landfill. The total estimated project cost for this alternative is $10,127,000. A cost breakdown is presented in Table 2-1. The capital cost of this disposal option is much less than either the offsite disposal or incineration options (see Table 2-2). However, this disposal option has operating and maintenance costs that will continue throughout the life of the landfill. Continuing costs associated with onsite disposal include inspection and periodic repair of the landfill cap, leachate collection/treatment, and groundwater and surface water monitoring.

TABLE 2-1
COST ESTIMATE
EXCAVATION AND ONSITE DISPOSAL
PORTAGE CREEK

Item	Qty	Unit	Unit Cost Sub.	Unit Cost Mat.	Unit Cost Labor	Unit Cost Equip.	Total Cost Sub.	Total Cost Mat.	Total Cost Labor	Total Cost Equip.	Total Direct Cost	Comments
1) TEMP. STREAM DIVERSION												
a. Excavation	16600	CY			.39	1.77			6474	29382	35856	
b. Shoring	56000	SF		.40	.50			22400	28000		50400	
c. Culvert Pipe-(2) 84"	100	LF		135.00	39.96	16.04		13500	3996	1604	19100	
d. Bedding - gravel	17	CY		10.50	2.20	6.11		179	37	104	320	
e. Backfill	300	CY		1.50	1.80	4.90			540	1470	2010	
f. Dewatering		LS	72000.00				72000				72000	
2) CONTAMINATED SEDIMENT												
a. Excavation	83000	CY			.68	1.78			56440	147740	204180	
b. Hauling	83000	CY			.48	1.38			39840	114540	154380	
c. Spreading	83000	CY			.23	.63			19090	52290	71380	
3) ONSITE DISPOSAL FACILITY												
a. Excavation Grading	37000	CY			.39	1.77			14430	65490	79920	
b. Install Mon. Wells	200	LF		15.00	25.00	25.00		3000	5000	5000	13000	
BOTTOM LINER												
c. Clay - 36"	55500	CY		9.00	3.95	7.76		499500	219225	430680	1149405	
d. Syn. Liner - 60-80 mil	499700	SF		.70	.20			349790	99940		449730	
e. Sand - 12"	18500	CY		6.50	2.50	6.48		120250	46250	119880	286380	
f. Filter Fabric	55500	SY		1.20	.16			66600	8880		75480	
g. Drainage Pipes (4"pvc)	5300	LF		.45	1.34			2385	7102		9487	
h. Leachate Tank	1	EA		1140.00	121.00	46.00		1140	121	46	1307	
CAP												
i. Sand - 12"	18350	CY		6.50	2.50	6.48		119275	45875	118908	284058	
j. Vent Pipes (4"pvc)	2800	LF		.45	1.34			1260	3752		5012	
k. Clay - 24"	36700	CY		9.00	3.95	7.76		330300	144965	284792	760057	
l. Syn. Liner - 30 mil	495600	SY		.30	.20			148680	99120		247800	
m. Sand - 12"	18350	CY		6.50	2.50	6.48		119275	45875	118908	284058	
n. Filter Fabric (2 layers)	110100	SY		1.20	.16			132120	17616		149736	
o. Soil - 18"	27550	CY		1.50	1.80	4.90		41325	49590	134995	225910	
p. Topsoil	9200	CY		5.50	1.80	4.90		50600	16560	45080	112240	
q. Revegetation	990	MSF		24.60	5.60	4.45		24354	5544	4406	34304	
MISCELLANEOUS												
r. Chain Link Fence (6')	4000	LF		7.50	1.59			30000	6360		36360	
Gate	1			58.00	11.35			58	11		69	
Cornerpost	4			39.00	9.95			156	40		196	
s. Dike (Around Disposal Area)	18000	CY			.80	1.35			14400	24300	38700	
t. Support Road	6900	SY		1.14	1.32	.25		7866	9108	1725	18699	
u. Env. Monitoring												
Lab Cost		LS	3100.00				3100				3100	
Sample Coll.	120	HR			30.00				3600		3600	
4) PORTAGE EXCAVATION												
a. Backfill	69000	CY		1.50	1.80	4.90		103500	124200	338100	565800	
b. Topsoil 6"	14000	CY		5.50	1.80	4.90		77000	25200	68600	170800	
c. Revegetation	750	MSF		24.60	5.60	4.45		18450	4200	3338	25988	
d. Silt Fence	2800	LF		2.30	.27			6440	756		7196	
							30100	2287403	1172138	2111377	5653017	
[illegible] @ 13% of Labor [illegible]									152378		[illegible]	
Labor @ 15% of Labor Cost									175821		[illegible]	
Material @ 5% of Material Cost								114370			114370	
Subcontract @ 10% of Sub. Cost							3010				3010	
Total Direct Cost							98110	2403873	1500336	2111377	6103696	
Indirects @ 50% of Total Direct Labor Cost									750168		750168	
Profit @ 10% Total Direct Cost											610370	
											7464233	
Health & Safety Monitoring @ 6%											447854	
Total Field Cost											7912087	
Contingency @ 20% of Total Field Cost											1582417	
Engineering @ 8% of Total Field Cost											632967	
TOTAL COST THIS PAGE											10127470	

TABLE 2-2

COST SUMMARY FOR ALTERNATIVES

	Alternative	Approximate Implementation Time		Estimated Capital Cost
A)	No Action for Entire River	-----		-----
	• PORTAGE CREEK/BRYANT MILL PONDS			
B)	Channel Lining and Soil Cap	1 yr		$ 1,562,000
C)	Channel Lining and Impermeable Cap	1 yr		2,707,000
D)	Excavation and Offsite Disposal	3 yr		39,782,000
DD)	Excavation and Onsite Disposal*	4 yr		10,127,000
DDD)	Excavation and Incineration*	5-7 yr	(low)	56,004,000
			(high)	403,059,000
D1)	Permanent Diversion and Soil Cap	1 yr		1,641,000
	• DRAWN DOWN DAMS			
E)	Channel Lining and Soil Cap	3 yr		59,603,000
	(no channel lining option)	(2 yr)		47,032,000
E1)	Channel Lining and Buffer Zone	2 yr		21,735,000
	(no channel lining option)	(1 yr)		8,717,000
F)	Channel Lining and Impermeable Cap	3 yr		120,630,000
	(no channel lining option)	(2 yr)		108,146,000
G)	Excavation and Onsite Disposal	4 yr		108,116,000
	• IMPOUNDED DAMS			
H)	Dredging and/or Excavation, and Upland Disposal	5 yr		110,045,000
I)	Channel Dredging, Channel Lining, and Soil Cap (Otsego City Dam)	3 yr		23,945,000
J)	Channel Dredging, Channel Lining, and Impermeable Cap (Otsego City Dam)	3 yr		51,387,000
	• DAM REMOVAL**			
	Plainwell			1,293,000
	Otsego			2,421,000
	Trowbridge			4,820,000
	Total	1 yr		$ 8,534,000

* Evaluated in this Addendum. All other values from the draft Feasibility Study Report.

** Costs provided by MDNR (J. Hayes memo of October 12, 1984).

3.0 EXCAVATION AND INCINERATION

Description

This alternative requires complete excavation of all contaminated sediments in Portage Creek, and subsequent incineration to destroy the PCBs. Assuming a 3-foot depth of excavation over the entire area, 83,000 cubic yards would be the total excavation volume. Since the sediments should be dewatered as much as possible prior to incineration, a temporary stream diversion would be constructed to allow the sediments to dewater naturally. Well points may also be used if additional dewatering is required. After excavation is completed, the excavated area would be backfilled and revegetated. A natural channel would, therefore, be reestablished to convey the Portage Creek flow.

Many of the sediment samples taken in the Portage Creek/Bryant Mill Pond area exhibited PCB concentrations greater than 50 ppm. Therefore, under TSCA (40 CFR, Part 761.60), these sediments must be disposed either by incineration or in a chemical waste landfill. Under this alternative, the sediments would be incinerated.

Incineration is a process that uses thermal oxidation to destroy organic substances at temperatures in excess of 2000°F. This process will effectively destroy PCBs and other organic compounds found in the sediment. However, the incineration process is a highly inefficient thermal process. Sediments, even after dewatering, would contain approximately 30 percent water. Because of the relatively high water content and the lack of combustible organics in the sediment, essentially all of the fuel required would have to be externally supplied. Thus, large amounts of fuel would be required to supply energy input to the system.

Incineration of the Portage Creek sediments could be most efficiently implemented by the use of an onsite mobile incinerator. The availability of an off site, commercial incineration facility is uncertain at this time. Only a limited number of commercial facilities have been approved for PCB incineration, and they most likely will have large backlogs for the foreseeable future. Also, the use of a mobile, onsite incinerator would eliminate the problems and high cost associated with the transport of large volumes of contaminated sediments.

PCB incineration is regulated under TSCA and the incinerator must comply with the requirements specified in 40 CFR, Part 761.70. Basic requirements specified under TSCA include: (1) air emissions regulation; (2) combustion efficiency requirement of at least 99.9 percent; (3) extensive measuring and monitoring requirements; and (4) various other operating procedures and requirements. The incinerator must be approved by the appropriate EPA Regional Administrator or the Assistant Administrator for pesticides and toxic substances.

There are some disadvantages associated with the incineration process with regard to public perception and acceptance, regulatory concerns, and very high costs. Since use of an onsite incinerator would, unavoidably, be close to residential and commercial areas, public perception of the incineration alternative will be a detriment to eventual approval and implementation. The proximity of residential areas to the site presents a clear source of public awareness and opposition to the incineration of PCB-contaminated materials within the area. Also, concerns may arise with regard to the possible formation and undetected emission of by-products such as polychlorinated dibenzofurans or dioxins as a result of the incomplete combustion of PCBs.

Another problem is that, although a mobile unit can be approved by the Regional Administrator of the EPA, extensive testing and permitting are required. Each incineration unit would have to undergo individual trial burns and permitting, which would be a costly and time-consuming process. It may take several years to complete the necessary permitting procedures.

The incineration rate of a mobile incinerator is also much less than the average rate of dredging or excavation. Several incinerators may be required, or material may have to be stored in a temporary facility. Depending on the characteristics of the incinerator residue, it may be considered a hazardous waste; therefore, it may require disposal in a secure landfill at an additional cost. Since current regulations do not require incineration of PCB contaminated sediments, it may be difficult to justify the expense of incineration, when more cost-effective alternatives are available.

Feasibility

Although the excavation and incineration alternative is very costly and complex, it is technically feasible. Assuming that excavation is feasible, the limiting constraint would be the availability of an approved, permitted, mobile incinerator. A number of permits are required to operate a mobile PCB incinerator.

Under Federal requirements, a TSCA permit is required to assure compliance with the TSCA regulations regarding PCB incineration. If the sediment contains any contaminants which are regulated under RCRA, a RCRA permit, issued by the EPA regional office, is also required. Also, the ash residue from the incinerator may be considered hazardous under RCRA and would have to be disposed of accordingly, unless it is delisted by EPA. The process water from the incineration operation may also be considered hazardous and either require a National Pollutant Discharge Elimination System (NPDES) Permit, or may be delisted by the EPA. The current lack of data on the possible presence of other contaminants in the sediments of Bryant Mill Pond prevents a more conclusive evaluation of permitting issues. For the TSCA and RCRA permits, public hearings are required to inform the public of the proposed incineration activities.

The State of Michigan will issue an MDNR permit under Michigan State hazardous waste regulations. Two permits may be required -- a waste permit, and a site-specific air quality permit. The City of Kalamazoo may require a local building permit, even though the incinerator is only a temporary facility.

Time and Cost

For the large volume of sediments in Portage Creek, excavation and incineration represents a very expensive and time-consuming alternative. The time required for the incineration process alone, using only one mobile incinerator, is estimated to be 5 years. (This is based on an incinerator burning 3 tons/hour, operating 18 hours/day and 360 days/year.) This is in addition to the time required to obtain the necessary permits and mobilize the equipment, which could take an additional several years. Of course, the incineration time could be reduced by using more than one incineration unit. For example, the use of two units would reduce the incineration time to 2-1/2 years, while the use of five units would reduce the incineration time to 1 year. The time required for permitting and trial burns would be expected to increase for multiple units, however.

The controlling factor will be the incineration rate. The incineration rate of a mobile incinerator is approximately 3 tons/hour, whereas the excavation rate of even a small dragline or backhoe ranges from 30-60 tons/hour. Either the excavation could be done all at once and the material stored in a temporary facility, or a small backhoe or dragline could be kept on site throughout the incineration process to continuously feed the incinerator(s).

Major costs associated with the incineration option include incinerator mobilization, permitting, and operating costs. Estimated operating costs vary widely; therefore, a range of costs is presented. Total estimated project costs for this alternative range from $56,004,000 to $403, 059,000. Cost breakdowns are presented in Tables 3-1 and 3-2. The low cost was estimated based on a predicted operating cost of a TSCA-permitted, transportable, PCB incinerator that has been developed by GA Technologies, Inc. of San Diego, California. The high cost is based on actual field operating costs of a mobile PCB incinerator used by EPA to incinerate soil in a pilot demonstration project at Times Beach, Missouri.

TABLE 3-1
COST ESTIMATE (LOW RANGE)
EXCAVATION AND INCINERATION
PORTAGE CREEK

Item	Qty	Unit	Unit Cost Sub.	Unit Cost Mat.	Unit Cost Labor	Unit Cost Equip.	Total Cost Sub.	Total Cost Mat.	Total Cost Labor	Total Cost Equip.	Total Direct Cost	Comments
1) TEMP. STREAM DIVERSION												
a. Excavation	16600	CY			.39	1.77			6474	29382	35856	
b. Shoring	56000	SF		.40	.50			22400	28000		50400	
c. Culvert Pipe-(2) 34"	100	LF		135.00	39.96	16.04		13500	3996	1604	19100	
d. Bedding - gravel	17	CY		10.50	2.20	6.11		179	37	104	320	
e. Backfill	300	CY		1.50	1.80	4.90			540	1470	2010	
f. Dewatering		LS	72000.00				72000				72000	
2) CONTAMINATED SEDIMENT												
a. Excavation	83000	CY			.68	1.78			56440	147740	204180	
3) INCINERATION :												
PREPARATORY												
a. Permitting		LS	125000.00				125000				125000	
b. Site Prep.		LS	50000.00				50000				50000	
c. Mobilization		LS	80000.00				80000				80000	
d. Operator Train.		LS	100000.00				100000				100000	
e. Trial Burn		LS	125000.00				125000				125000	
INCINERATION												
f. Operating Costs	101000	TONS	340.00				34340000				34340000	
DEMOBILIZATION												
g. Decontamination		LS	20000.00				20000				20000	
h. Demobilization		LS	30000.00				30000				30000	
4) RESTORE EXCAVATION												
a. Backfill	69000	CY		1.50	1.80	4.90		103500	124200	338100	565300	
b. Topsoil - 6"	14000	CY		5.50	1.80	4.90		77000	25200	68600	170800	
c. Revegetation	750	MSF		24.60	5.60	4.45		18450	4200	3338	25988	
d. Silt Fence	2800	LF		2.30	.27			6440	756		[illegible]	
							34992000	241469	249843	590337	36073649	
Burden @ 13% of Labor Cost									32480		32480	
Labor @ 15% of Labor Cost									37477		37477	
Material @ 5% of Material Cost								12073			12073	
Subcontract @ 10% of Sub. Cost							3499200				3499200	
Total Direct Cost							38491200	253542	319800	590337	39654879	
Indirects @ 50% of Total Direct Labor Cost									159900		159900	
Profit @ 10% Total Direct Cost											3965488	
											43780267	
Health & Safety Monitoring @ .04											1751211	
Total Field Cost											45531478	
Contingency @ 20% of Total Field Cost											9106295	
Engineering @ 3% of Total Field Cost											1365944	
TOTAL COST THIS PAGE											56003717	

TABLE 3-2
COST ESTIMATE (HIGH RANGE)
EXCAVATION AND INCINERATION
PORTAGE CREEK

Item	Qty	Unit	Unit Cost Sub.	Unit Cost Mat.	Unit Cost Labor	Unit Cost Equip.	Total Cost Sub.	Total Cost Mat.	Total Cost Labor	Total Cost Equip.	Total Direct Cost	Comments
1) TEMP. STREAM DIVERSION												
a. Excavation	16600	CY			.39	1.77			6474	29382	35856	
b. Shoring	56000	SF		.40	.50			22400	28000		50400	
c. Culvert Pipe-(2) 24"	100	LF		135.00	39.96	16.04		13500	3996	1604	19100	
d. Bedding - gravel	17	CY		10.50	2.20	6.11		179	37	104	320	
e. Backfill	300	CY		1.50	1.80	4.90			540	1470	2010	
f. Dewatering		LS	72000.00				72000				72000	
2) CONTAMINATED SEDIMENT												
a. Excavation	83000	CY			.68	1.78			56440	147740	204180	
3) INCINERATION :												
PREPARATORY												
a. Permitting		LS	125000.00				125000				125000	
b. Site Prep.		LS	50000.00				50000				50000	
c. Mobilization		LS	80000.00				80000				80000	
d. Operator Train.		LS	100000.00				100000				100000	
e. Trial Burn		LS	125000.00				125000				125000	
INCINERATION												
f. Operating Costs	101000	TONS	2560.00				258560000				258560000	
DEMOBILIZATION												
g. Decontamination		LS	20000.00				20000				20000	
h. Demobilization		LS	30000.00				30000				30000	
4) RESTORE EXCAVATION												
a. Backfill	69000	CY		1.50	1.80	4.90		103500	124200	338100	565800	
b. Topsoil - 6"	14000	CY		5.50	1.80	4.90		77000	25200	68600	170800	
c. Revegetation	750	MSF		24.60	5.60	4.45		18450	4200	3338	25988	
d. Silt Fence	2800	LF		2.30	.27			6440	756		7196	
							259212000	241469	249843	590337	260293619	
Burden @ 13% of Labor Cost									32480		32480	
Labor @ 15% of Labor Cost									37477		37477	
Material @ 5% of Material Cost								12073			12073	
Subcontract @ 10% of Sub. Cost							25921200				25921200	
Total Direct Cost							285133200	253542	319800	590337	286296859	
Indirects @ 50% of Total Direct Labor Cost									159900		159900	
Profit @ 10% Total Direct Cost											28629686	
											3150864[illegible]	
Health & Safety Monitoring @ .04											12603457	
Total Field Cost											32768[illegible]	
Contingency @ 20% of Total Field Cost											65537935	
Engineering @ 3% of Total Field Cost											98[illegible]6[illegible]3	
TOTAL COST THIS PAGE											407058643	

4.0 RESPONSES TO GENERAL COMMENTS

General Comment No. 1

A response to the concern raised in this comment regarding the lack of an explicit modeling of Bryant Mill Pond must consider several different issues within the overall FS framework. These include the relationship of the various modeling options to that utilized in the FS, the relationship and impacts of the modeling approach to the remedial action recommendations for Bryant Mill Pond, and similar considerations for the remedial action scenarios for the overall Kalamazoo River study area.

The two options available to model Bryant Mill Pond would be to incorporate the pond into the current model as an additional reach (thereby treating it in a manner similar to all other reaches), or to utilize a totally separate model of the local Bryant Mill Pond environment. Under the former approach, the reach would be schematized as the first reach affected by PCBs. Consequently, either a reduced constant source term (e.g., from leachate release) would have to be assumed with no supporting basis or a zero PCB loading would have to be assigned to Bryant Mill Pond. Due to the steady-state nature of the model, each case would likely result in a PCB concentration approaching background in Bryant Mill Pond. On the other hand, the unfavorable conditions that would exist until background conditions are reached would not be accounted for in the model. Whether a no-action alternative could be substantiated by the results of such modeling approach would depend on both the length of the interim period and the impacts caused by the progressive release of PCBs to downstream reaches. The field evidence that a significant improvement has not occurred over the multi-year period of observations, and the large volume of contaminated sediments still remaining in Bryant Mill Pond, indicate that the interim period would be unacceptably long. Continuing releases of PCBs to downstream reaches as a mechanism of "cleaning up" Bryant Mill Pond is also not acceptable.

The other option would be to develop a dynamic model of the Bryant Mill Pond system. Such a model would require consideration of numerous dynamic processes, including the erosion of the banks and bottom of the pond, the infiltration of surface water through contaminated remnant deposits, the recharge from groundwater flow and associated PCBs, the possible release of PCBs from the onsite disposal ponds, and natural transformation processes. The testing and application of such an unsteady-state model was deemed to be beyond the scope of the available data base, and a decision was made by MDNR not to pursue such a comprehensive model for purposes of the FS.

The most critical issue in responding to General Comment No. 1 is not whether a more comprehensive, unsteady-state model would be better--it would be at an expanded cost and effort - but rather whether the approach used in the FS is consistent with the objectives and conclusions of the study. This requires a consideration of both the local and system-wide study areas. In the case of Bryant Mill Pond itself, there is little doubt that natural physical, chemical, and biological processes would eventually reduce the PCB loadings to downstream reaches. However, as discussed above, the long-term release of PCBs from a well-defined area of concern is not judged to be an acceptable alternative for "cleaning up" Bryant Mill Pond. Considering that a large volume of sediments with PCB levels greatly exceeding those in other reaches is currently confined to a manageable area within Bryant Mill Pond, it would be judicious to implement an isolation or removal action before the environmentally stable PCBs are dispersed throughout the lower Kalamazoo River system.

The principal use of the model for the overall Kalamazoo River system was to provide a convenient measure of the relative effectiveness of alternative actions in relation to the basic remedial program goal of lowering PCB levels in fish to less than 2 ppm. The selection of an appropriate source term to represent Bryant Mill Pond is important since any PCB reductions achieved by a remedial action at Bryant Mill Pond would necessarily be compared to the "no-action" results. While recognizing that the Bryant Mill Pond loading would eventually be reduced, a decision was made to utilize the current loading value as a steady-state constant load in preference to an assumed lesser value. Since it is expected that a considerable period of time would be required to achieve a significant reduction in Bryant Mill Pond loadings, the assumption of a lesser loading term would underestimate the near-term problem of primary concern. Even under the assumed current loading value, only the most upstream reach on the Kalamazoo River (Reach 2) was found to violate the 2 ppm criterion for carp under the no-action scenario. This is important for two reasons. First, the model results did not lead to a recommendation for remedial action other than at Bryant Mill Pond. On the other hand, if PCB levels in fish in other parts of the river had been predicted to remain excessively high under the no-action scenario so that additional remedial actions would be recommended, MDNR would agree that the assumed source at Bryant Mill Pond would have to be further analyzed and a refined modeling study completed. Second, if one had selected a reduced loading term upfront with similar model predictions and a recommendation for no further action, the issue would be raised as to the validity of the reduced loading term and further studies would again be necessary. In retrospect, by selecting a conservative loading term, the recommendation for no immediate remedial action in the Kalamazoo River was more easily justified and the need for more detailed modeling studies was minimized.

<u>General Comment No. 2</u>

The initial issue of this comment, that an assessment of Morrow Pond is prohibited if the adjacent reaches are not modeled, is true. However, since Morrow Pond was not within the designed study area for the FS, this condition should not be construed as a shortcoming of the model. The model results for Alternative C show that the criterion of 2 ppm in fish will be satisfied in all reaches of the lower Kalamazoo River under steady-state conditions if Bryant Mill Pond is eliminated as a PCB source. It can be inferred from this finding that PCB loadings from the Kalamazoo River upstream of Portage Creek do not singularly represent a significant problem. Thus, the decision to simply treat this contribution as a constant source of PCBs rather than to include the upstream reaches in the model and decision framework is justified.

The second concern, that a "..... substantial conceptual error" was made in the model when accounting for the upstream load, apparently originated from a misunderstanding of the governing equations of the model. Equation (1) on page 3-4 of the FS report does indicate that the PCB mass loading from the upstream reach of the Kalamazoo River is uniformly distributed along Reach 2 for numerical purposes. However, the contribution of flow from the upstream reach is not distributed; rather, all flow enters Reach 2 at the upstream boundary. Although distributed differently, both the mass of PCBs and the mass of water from the Kalamazoo River upstream from Portage Creek are properly conserved in the model. As a result of this modeling approach, the mixing of the PCB load from Portage Creek with a portion of the distributed load from the upstream reach would actually result in a PCB concentration at the head of Reach 2 that is less than the 20 ng/l "complete mix" value cited in the comment.

The distribution of PCB mass along the length of Reach 2 is not the origin of the 74 ng/l average value predicted by the model for the reach. Rather, this increased value is an artifact of model calibration which indicated a contribution of PCBs from processes internal to the reach. For example, recent field measurements at the downstream end of Reach 2 yield an average PCB concentration of 81 ng/l. This value is close to the model prediction of 74 ng/l, and greatly exceeds the value of 20 ng/l that would be expected by a simple mass balance of the upstream loads.

Although somewhat unexpected, the observed increase in the PCB mass rate of flow is not unique to Reach 2. With reference to Table 4-1, which was completed by averaging the monthly values given in Tables 3-2 through Table 3-11 of the FS report, a relatively constant increase in the PCB mass rate of flow of 3-10 lbs/year/mile occurs throughout the Kalamazoo River upstream from Lake Allegan Dam. The source of this PCB contribution is unknown, but could include a contribution from the sediments or remnant deposits, subsurface flow contributions, and undetected leakage from past or present disposal activities. The increased loading can be put in perspective by considering that the equivalent daily contribution is only on the order of a few tenths of an ounce of PCBs per mile of river.

TABLE 4-1

SUMMARY OF PCB MASS RATE OF FLOW BY REACH

Reach	Length (mile)	Ave. Flow (cfs)	Measured PCB Conc. (ng/l)	PCB Mass Rate of Flow (lbs/year)	Change in PCB Mass Rate (lbs/year)	Change Per Unit Length (lbs/year/mile)
US KALA	N/A	922	13	23.6		
				39.9		
1	1.7	63	132	16.3		
2	14.3	985	50	96.8	56.9	4.0
3	2.0	985	56	108.4	11.6	5.8
4	1.7	1,108	49	106.7	-1.7	-1.0
5	5.0	1,152	55	124.5	17.8	3.6
6	4.0	1,193	69	161.8	37.3	9.3
7	7.3	1,208	80	190.0	28.2	3.9
8	1.6	1,210	96	228.3	38.3	23.9
9	10.4	1,247	129	316.2	87.9	8.5

From a modeling standpoint, the unknown origin of this contribution prohibits a conclusive treatment of the dominant process in the model. The option was to calibrate the various rate constants to yield model results representative of the observed values.

General Comment No. 3

As described in the FS report, the BCF for PCBs can be affected by various biological, physiological, and environmental factors. The results presented in Appendix B of the FS report indicate that the goodness of linear correlation between PCB concentration in fish and the major biological/physiological factors varied with both the location and year of the sampling. Thus, in order to obtain a reliable BCF value for a specific reach, considerable sampling must be conducted.

The reviewers chose an average PCB concentration of 0.8 ppm to indicate the average PCB level in Portage Creek fish, yielding a BCF value of approximately 5,900 based on available water column data. For several reasons, NUS does not judge this BCF value to be reliable. First, the average PCB level in Portage Creek fish and the associated BCF value were calculated from a single set of fish samples collected in July, 1985. Not only does the use of a single set of data create a concern as to the reliability of the resultant BCF value, but the statistical analysis of fish data reported in Appendix B showed the July, 1985 data to be particularly poorly behaved relative to data sets from previous years. Second, the July 1985 fish samples were actually collected in Bryant Mill Pond above the dam. The fish would, therefore, have free access to much cleaner upstream areas. If the collected samples actually spent more of their life in clean upsteam waters, a much lower PCB body burden would be expected. Third, the statistical correlation was greater in the lower reaches of the Kalamazoo River than in the upper reaches. This observation could be the result of more favorable habitat in the lower reaches, which would minimize the influence and possible masking effects of various environmental stresses on PCB body burdens in fish. Bryant Mill Pond may be particularly stressed by factors other than PCBs. Finally, the BCF value of 5,882 calculated by the reviewers is considered to be unreasonably low based on the values obtained throughout the Kalamazoo River system.

Since the computed value of 5,882 was deemed by NUS not to be reliable, the BCF value for Reach 2 was selected for Portage Creek due to the proximity of the two reaches and the fact that no physical barrier to fish migration exists between the two reaches. On the other hand, the so-called Portage Creek samples from 1985 were isolated from Reach 1 by the Bryant Mill Pond Dam and would not be considered representative of the reach. The fact that the BCF value for Reach 2 was the maximum value observed for the Kalamazoo River was not the reason for its selection. It is of interest, however, to consider that the predicted PCB concentration for carp in Portage Creek would be 3.4 ppm even if the minimum BCF value (26,756) for the Kalamazoo River was used. The 3.4 ppm would still exceed the 2 ppm criterion.

General Comment No. 4

The comparison of model predictions with field observations is the method commonly utilized to test the performance of a mathematical model. Preferentially, the available data base would include two sets of independent data representing different types of field conditions to allow both calibration and verification testing. In the case of the Kalamazoo River, the available data base was not fully consistent with the needs of model testing. The result was that a somewhat unconventional calibration/verification procedure had to be implemented to test model performance.

The typical approach to model calibration and verification would involve two sets of data from different years. A review of the Kalamazoo River data base revealed that the data was generally scattered in time and location, and that adequate data sets for specific years were not available. Further, temporal trends in the data were not readily apparent and any two sets of data would not have been sufficiently different to provide an independent verification run. The option selected by NUS was to develop a "typical year" data set by averaging the available data from several different years by month. In so doing, it was observed that the water column PCB levels exhibited a seasonal variability along with the hydrologic parameters. This led to the decision to utilize two "six-month" data sets for model calibration and verification, since the capacity of the model to relate hydrologic conditions to PCB levels would consequently be tested. It should also be emphasized that the resultant data base did not represent "...one year's worth of data", as stated in General Comment No. 4, but rather average monthly values for all years of sampling.

The existing data base is also not optimal for testing a steady-state model since the present field situation does not represent a fully steady-state condition. The significant decrease in PCB levels predicted by the model compared to recently measured levels provides evidence that a dynamic condition still exists. Once a decision was made to utilize a steady-state model to satisfy the study objectives within the constraints of the available data, it became imperative to transform the model into a pseudo-time variable version to perform the calibration/verification testing using actual field data. In other words, the so-called "...unorthodox" approach to model testing was necessitated by actual field conditions, and represents a meaningful method within the data constraints.

General Comment No. 5

Since the model reported in the FS was developed for purposes of this study, MDNR requested that NUS provide detailed written documentation of the underlying theory and simplifying assumptions. A presentation at this level of detail is admittedly not necessary to report the study findings in relation to the remedial action decision process. On the other hand, the report is structured so that most of the information on model development and testing can be disregarded if so desired.

General Comment No. 6

Most of the concerns expressed in this comment have been previously addressed as part of other responses. The issue as to whether an unsteady-state model would have been "better" cannot be factually resolved--the selection of the basic modeling approach is a complex decision involving the study objectives, the available data base, and the trade-off between the level of complexity and the related level of effort and costs.

In the case of the Kalamazoo River PCB study, the deficiencies of the data base in both time and space and the lack of clearly demarcated temporal trends over the short period of data collection inhibited the use of an unsteady-state model. This is particularly true given that a simple "one-box" model such as was used in the Saginaw River study would not be sufficient, and the various types of system components would require different mathematical frameworks and controlling processes (e.g., dam pools, drawn down dam pools, free-flowing reaches, etc.). By selecting a steady-state model, and thereby eliminating the time-variable dimension, the spatial variability of the system in the direction of flow could be accounted for without appreciably increasing the numerical complexity.

When formulating the modeling strategy, it was recognized that remedial actions within the Kalamazoo River would likely be of a significantly larger scale and cost than those pertaining to the upstream PCB source at Bryant Mill Pond. An important objective of the modeling study was, therefore, to quantify the relative effectiveness of the various clean-up options to a level of detail sufficient to develop general conclusions as to relative cost-effectiveness. In other words, the model was intended to provide input into the decision framework regarding the relative benefits of each remedial action to ascertain, for example, if a clean-up option on the Kalamazoo River that involved an order-of-magnitude higher cost would provide proportionate benefits. Due to the wide range of costs reported in the FS, the decision that a steady-state model would suffice to assess the relative impacts appears justified.

In those cases where a recommended course of action could not be justified within the limitation of the model, this was noted in the FS report and a recommendation for further study was made. This is exemplified by the option to reimpound the Plainwell, Otsego, and Trowbridge Dams.

<u>General Comment No. 7</u>

Many of the concerns expressed in General Comment No. 7 result from an apparent misunderstanding of the model input and quantification procedures. The available field data on PCB-levels in sediments did not provide sufficient spatial coverage to perform an area-weighted averaging process. On the other hand, the inference that the MDNR sampling strategy and the subsequent use of the data were biased to high PCB levels is not necessarily true. With a few exceptions of single point sampling, the MDNR samping programs employed several transects or several sampling locations along the longitudinal axis of the reaches. In addition, any sampling programs recommended by NUS for model support would not have specifically targeted areas of high PCB concentration, since it is recognized that non-representative samples often lead to difficulties in model calibration.

The PCB data selected for use in determining "point sediment loadings" was purposely restricted to the contaminated remnant areas above the water surface. The reason for this selective use of the data was that the mass calculations were associated with PCB contributions to the reach exclusive of the submerged sediment layer. The sediments below the water surface were separately taken into account by the internal process of sediment resuspension.

The determination of "point sediment loadings" was targeted toward the conservation of mass for both suspended sediment and PCBs, and in actuality accounted for diffuse sources of solids in the watershed. The underlying assumption used in the calculation was that the contribution of sediment mass from the watershed versus the amount from contaminated remnant deposits is proportional to the respective surface areas. Field measurements of suspended solids were first used to compute a mass inflow of solids from the watershed within a reach, and a PCB loading was then introduced only for the calculated portion of the solids loading associated with the remnant areas. Such an approach would not bias the loadings toward higher PCB values, as claimed in General Comment No. 7. In fact, the method may underestimate the diffuse PCB loadings since the remnant areas immediately adjacent to the river would likely contribute a higher percentage of the solids loading than predicted by simple drainage area scaling.

General Comment No. 8

This comment generally reasserts the issues from previous comments and the related implications to the FS findings. It is believed that the responses to General Comments No. 1 through No. 7 have adequately addressed these issues, and no repetition appears necessary at this point.

5.0 RESPONSES TO SPECIFIC COMMENTS

1. Addressed in other comments and responses.

2. Addressed in the response to General Comment No. 1.

3. The referenced statement was taken out of context. The model will indeed predict whether specific remedial actions will achieve the goal of 2 ppm in fish. By so doing, the relative effectiveness of various alternatives can be assessed relative to a quantitative measure of comparison. The reliability of the predicted values is recognized to be limited by the model simplications and the quantity and quality of the available data base, however, and the report (page 1-6) makes it clear that a decision on remedial actions must consider that the model predictions are not 100 percent reliable.

4. Addressed in the response to General Comment No. 7.

5. Page 2-2 only reports the percentage of samples with PCB levels exceeding 50 ppm. There is no statement that an equivalent percentage of sediments in the area contain PCBs in excess of 50 ppm.

6. Refer to the response to Specific Comment No. 5.

7. Care was taken in interpreting and using the results of the trend analysis due to a recognition of data limitations. Statements are provided in the report that explicitly account for such qualifications of the results.

8. Refer to the response to Specific Comment No. 7.

9. The report simply states that the results of the single sample analysis support a general upfront assumption that free-flowing reaches of the river with sandy-gravelly bottoms would be free of PCB-contaminated sediments. No statement is made that the reach is, in fact, free of PCBs. The statement made in this comment that most areas of Portage Creek and the Kalamazoo

River are similar to this reach is erroneous. Upstream from Lake Allegan Dam, most of the river is currently impounded or remains affected by the previous impoundment and remnant dam structures.

10. The NUS scope of work did not include a remedial investigation phase that would have potentially allowed an independent assessment of the Kalamazoo River PCB problem. Rather, the Feasibility Study was to be completed through the use of previous studies and past and current field data collection efforts by others. The inclusion of citations from previous reports that support the underlying assumptions and findings of the NUS study are, therefore, meaningful and appropriate.

11. No response necessary.

12. The 1981 carp samples from Portage Creek were collected downstream from Bryant Mill Pond. As a result, the fish were not prohibited by physical barrier from migrating into the Kalamazoo River both upstream and downstream from the Portage Creek confluence. The uncertainty in the migration patterns of individual fish inhibits the use of the resultant data in establishing a relationship between observed PCB body burdens and PCB levels in Portage Creek. The data were, therefore, omitted from the Portage Creek data in the summary table. (See also General Comment No. 3).

13. A positive correlation between PCB body burden and body fat is well-established. The use of a parameter that provides a measure of the PCB body burden per unit of fat content to assess the degree to which previously collected data satisfies an expected behavior pattern appears to be both appropriate and creative. The application of linear regression analysis to evaluate the degree of correlation between two variables in a given set of samples is widely accepted and requires no demonstration of mechanistic validity.

14. The statements made on page 2-28 regarding the potential relationship between the state of the local environment and PCB levels in fish should be considered as a postulated explanation of field observations rather than as "theory" as stated in the comment. It is not unusual to search for plausible reasons when anomalous or inconsistent field observations occur. The statements made on page 2-28 are not definitive; the reader should be able to infer from the wording that the statements are postulated explanations that have not been quantitatively verified.

15. MDNR did not include Morrow Pond as part of the study area for the subject FS. A determination of whether a remedial action is necessary at Morrow Pond is, therefore, beyond the scope of this FS. More importantly, this issue has no direct impact on the recommendations of the FS and therefore does not require an explicit consideration. As discussed in General Comment No. 2, the model results would indicate that any PCB contributions from Morrow Pond do not represent a significant problem to the downstream study area.

16. The levels of PCBs in fish in other areas and associated regulatory actions are of importance only as they relate to MDNR's efforts to effect consistent policy and program decisions throughout its jurisdiction. Such information is not valuable to a determination of the relative cost-effectiveness of alternative remedial actions, however, and thus does not have to be considered in the FS.

17. Refer to the response to Specific Comment No. 10.

18. Addressed in the response to General Comment No. 7.

19. Refer to the response to Specific Comment No. 9.

20. Addressed in the responses to General Comment No. 1 and No. 6.

21. Addressed in the response to General Comment No. 4.

22. Refer to the response to Specific Comment No. 3.

23. The increased difficulty of applying the model as a management tool when the kinetic terms are maintained is small. In many cases, the exclusion of the term can be achieved simply by setting the associated rate constant to zero. On the other hand, by retaining the terms, a single version of the model becomes available for use at other sites where the kinetic processes are a critical consideration and an adequate data base is available to reliably test and apply the related mathematical formulation.

24. Addressed in the responses to General Comments No. 1 and No. 2.

25. Addressed in the response to General Comment No. 5.

26. Addressed in the response to General Comment No. 7.

27. No quantitative documentation is available on the resuspension activity of carp in the Kalamazoo River impoundments. However, the relative impact of this process cannot be termed "speculative", as stated in the comment. The attached letter provides evidence that large populations of carp (as is the case in the lower impoundments) can play a dominant role in sediment resuspension. There is also evidence that an extensive layer of "fluff" overlies the sediment layer in Lake Allegan, which would be particularly susceptible to (and likely a result of) disturbances by carp.

28. Addressed in the response to General Comment No. 4.

29. The statement made in this comment is valid to some extent, particularly in those reaches where point sediment loadings from remnant sediment deposits were accounted for. However, in other reaches (e.g., Reach 2), model calibration focused on the kinetic source and sink terms in order to adequately reproduce the observed gain in PCB mass within the reach. It is also noteworthy that the remedial actions assessed via the model generally involved a reduction in a source term. Since the model response would be

NATURAL RESOURCES COMMISSION
ACOB A. HOEFER
M. LAITALA
HILARY F. SNELL
PAUL H. WENDLER
HARRY H. WHITELEY
JOAN L. WOLFE

STATE OF MICHIGAN

WILLIAM G. MILLIKEN, Governor

DEPARTMENT OF NATURAL RESOURCES

HOWARD A. TANNER, Director

District 14 Headquarters
2455 N. Williams Lake Road
Pontiac, Michigan 48054

January 11, 1983

Dayle Harrison
Kalamazoo River Preservation Association
P O Box 280
Saugatuck, Michigan 49453

Dear Mr. Harrison;

Per your telephoned request on January 10, 1983, the effect of our carp eradication program on the lower Huron River, Washtenaw and Wayne counties was quite striking in terms of "suspended" sediments.

While we took no quantitative or qualitative data, I can assure you that in 1300-acre Belleville Lake one could not see the bottom in six inches of water before the treatment. The chemical treatment in 1973 resulted in removal of 1000 pounds of carp per acre. Within days afterward, I could stand in two to three feet of water and see bottom.

Even today, water clarity is improved, allowing a view of the bottom in two feet of water and more at times. More importantly, was the establishment of a very good game fish fishery even with the reinfestation of carp. The carp population is small by comparison and has not resulted in water clarity problems as before.

Sincerely,

Ronald J. Spitler

Ronald J. Spitler
District Fisheries Biologist

RJS:br
cc: Johnson, District 12

expected to be sensitive to imposed changes in the boundary loadings, the predicted effects of the remedial actions were easily observed in the model output.

30. Addressed in the response to General Comment No. 2.

31. Figures 3-2 through 3-10 are admittedly difficult to interpret. This condition results from a decision to exhibit more than one set of information on each plot in order to reduce the total number of figures in the report. The advantage of these plots is the large amount of information provided on the sensitivity of several PCB mass terms to the full range of model input parameters. Even though some terms were shown not to be important to the predicted values, it was decided to present this information for completeness and to minimize any subsequent questions in this regard.

32. A relative scale of PCB concentration would have been more appropriate for use in Figures 3-11 and 3-12, as suggested in the comment. Nevertheless, the information provided in the FS report using absolute concentrations is meaningful and easily interpreted. The concentration values shown on the figures do not correspond to a particular reach. Rather, the values represent a baseline condition for the entire river that was computed in a consistent manner for all sensitivity runs.

33. Addressed in the response to General Comment No. 2.

34. Refer to the response to Specific Comment No. 3.

35. Addressed in the response to General Comment No. 3.

36. The text on page 3-56 does not state that 45 minutes per run is a constraint on model use. The time requirement was provided for informational purposes and represents one of many attributes of the model. The issue of the time variable assessment has been previously addressed in the response to General Comment No. 6.

37. No response to the initial part of this comment is necessary. Regarding the alternative of reimpoundment of Bryant Mill Pond, the MDNR has determined subsequent to the issuance of the FS report that such an alternative would not be acceptable to the State. This decision was in response to a proposal submitted to MDNR by Allied Paper. Consequently, the alternative will not be assessed by NUS as part of this response to comments.

38. The issue of future loadings from Bryant Mill Pond has been addressed in the response to General Comment No. 1. The load reduction values used in the model to represent the effects of remedial actions at Bryant Mill Pond were not "arbitrary assumptions" as stated in the comment. The revised loading values were based on an explicit consideration of how each type of action would reduce specific loading terms. Most actions (e.g., complete sediment removal or channel realignment) would essentially result in a zero future loading. An exception was the soil capping options, which were assumed not to be 100 percent efficient in eliminating the PCB source from the remnant sediment deposits. The values of 75 percent and 95 percent efficiency for the soil and impermeable caps, which were based on information provided by design engineers (see page 4-7 of the FS report), are considered reasonable for purposes of the FS and are consistent with values used by NUS at many other sites.

39. The concern expressed in this comment indicates that the information presented in Table 5-1 has been erroneously interpreted by the reviewers. The reduced loadings for Alternatives B, C, and D were only imposed on the source term for Reach 1 (i.e., Bryant Mill Pond/Portage Creek). No reduction was made on loads from the upstream Kalamazoo River, as actions on Portage Creek will not influence the reach of the Kalamazoo River upstream from the confluence.

40. Addressed in the responses to numerous general and specific comments.

41. Addressed in the response to General Comment No. 3.

42. Refer to the response to Specific Comment No. 3.

43. The referenced "... major conceptual errors" in the model have been disputed in many of the previous responses. Thus, the notion that the findings and recommendations of the FS are summarily invalid is not substantiated.

44. The response just given for the previous comment applies is this case also. In addition, it must be emphasized that the results of the model are but one consideration in the overall prioritization of remedial actions. The relationship of the model to the FS process was previously discussed in the response to General Comment No. 6.

45. Refer to the response to Specific Comment No. 27.

46. Although the reliability of model predictions is generally limited by data deficiencies, the underlying physical, chemical, and biological processes affecting PCB fate and transport in the Kalamazoo River system are adequately accounted for in the model. The mathematical framework used to represent these processes is consistent with widely-accepted practice. An exception is the modeling of future PCB releases to the water column if currently dewatered remnant deposits are permanently submerged as a result of dam reimpoundment. This process does not factor into the assessment of most remedial actions, but is a critical consideration to the effectiveness of a reimpoundment scenario. It is for this reason that the reliability of the model in assessing the effectiveness of remedial actions would be particularly suspicious if applied to the reimpoundment case.

47. Refer to the response to Specific Comment No. 37.

VARNUM, RIDDERING, SCHMIDT & HOWLETT

ATTORNEYS AT LAW

SUITE 800
171 MONROE AVENUE, N.W.
GRAND RAPIDS, MICHIGAN 49503
TELEPHONE (616) 459-4186
TELECOPIER (616) 459-8468

JAMES N. DeBOER, JR.
GORDON B. BOOZER
WILLIAM K. VAN T HOF
EUGENE ALKEMA
HILARY F. SNELL
PETER ARMSTRONG
ROBERT J. ELEVELD
KENT J. VANA
CARL E. VER BEEK
JON F. DeWITT
DONALD L. JOHNSON
DANIEL C. MOLHOEK
GARY P. SKINNER
TIMOTHY J. CURTIN
H. EDWARD PAUL
JOHN E. McGARRY
DIRK HOFFIUS
J. TERRY MORAN
BENHAM R. WRIGLEY, JR.
THOMAS J. MULDER
THOMAS J. BARNES
ROBERT D. KULLGREN
RICHARD A. KAY
LARRY J. TITLEY
BRUCE A. BARNHART
DENNIS C. KOLENDA
JEFFREY L. SCHAD
KAEL B. KENNEDY
THOMAS G. DEMLING
JOHN W. PESTLE
ROBERT P. COOPER
FRANK G. DUNTEN
TERRANCE R. BACON
NYAL D. DEEMS
RICHARD A. HOOKER
RANDALL W. KRAKER
PETER A. SMIT
JAMES D. GREGG
FREDRIC A. SYTSMA
JACK D. SAGE
MARK C. HANISCH
MARILYN A. LANKFER
THOMAS L. LOCKHART
ROBERT L. DIAMOND
BRUCE G. HUDSON
BRUCE GOODMAN
JOSEPH J. VOGAN
ERIC J. SCHNEIDEWIND
THOMAS A. HOFFMAN
TERESA S. DECKER
JEFFREY R. HUGHES
RICHARD W. BUTLER, JR.
LAWRENCE P. BURNS
ROBERT F. VAN PATTEN, JR.
MATTHEW D. ZIMMERMAN
WILLIAM E. ROHN
JOHN PATRICK WHITE
MYRA L. WILLIS
CHARLES M. DENTON
JUDY E. BREGMAN
THOMAS C. CLINTON
MARK L. COLLINS
JONATHAN W. ANDERSON
ROBERT G. BRODY
MICHAEL W. DONOVAN
JOHN W. BOLEY
CARL OOSTERHOUSE
ANDREA D. ANDREWS
WILLIAM J. LAWRENCE III
GREGORY M. PALMER
SUSAN M. WYNGAARDEN
KAPLIN S. JONES
STEPHEN P. AFENDOULIS
ROBERT A. HENDRICKS
DAVID E. KHOREY
BRIAN L. DOBBEN
MICHAEL G. WOOLDRIDGE
MICHAEL D. FISHMAN
JANET C. BAXTER
HEATHER E. HUDSON
PERRIN RYNDERS
STEPHEN J. DUNN
DEANNA S. SWISHER
MARK S. ALLARD
TIMOTHY E. EAGLE
JULIA K. STRONKS

OF COUNSEL
LAURENT K. VARNUM
ROBERT G. HOWLETT
JOHN L. WIERENGO, JR.
F. WILLIAM HUTCHINSON
CHESTER C. WOOLRIDGE
WILLIAM J. HALLIDAY, JR.

RICHARD L. SPINDLE
936-975
CARL J. RIDDERING
904-977
CLIFFORD C. CHRISTENS-
915-982

WALTER K. SCHMIDT
(RETIRED)

April 25, 1986

Stephen F. Schuesler
Assistant Attorney General
Environmental Protection Division
720 Law Building
Lansing, Michigan 48913

HAND DELIVER

Re: Comments on State of Michigan Feasibility Study of Alternatives - Kalamazoo River PCB Project

Dear Steve:

In accordance with our telephone conversation last week, we enclose the comments of Allied Paper on the NUS draft report issued in March of 1986 on the Kalamazoo River PCB project.

Based on these comments, it is our opinion that there are such serious flaws in the report that the conclusions relative to the proposed management alternatives are not supportable. Furthermore, in light of these flaws, we believe implementation of the options suggested in the report would be unreasonable.

After carefully reviewing the NUS report, Allied Paper remains convinced that there are ways of addressing the PCB problem in Portage Creek that are more sound both from an environmental point of view and from a cost point of view than those suggested in the NUS report.

We renew our offer to sit down with you or the DNR staff and discuss our concerns with respect to the NUS report in more detail. We enclose two extra copies of our letter and Allied's comments for the DNR Staff.

Yours truly,

VARNUM, RIDDERING, SCHMIDT & HOWLETT

Jon F. DeWitt

Jon F. DeWitt

JFD:jc
enclosure
cc: Thomas Flanagan
R. Richard Eaton

PRELIMINA

SELECTED REVIEW COMMENTS ON THE DRAFT REPORT

"Feasibility Study of Alternatives: Volume I and Appendices: Kalamazoo River PCB Project: Kalamazoo and Allegan Counties, March 1986" : NUS Corporation and MDNR

The following comments are based on an initial review of the NUS March 1986 Draft Report entitled "Feasibility Study of Alternatives" (Vol. 1 and Appendix) by staff of Limno-Tech, Inc. The comments are divided between General Comments and Specific Comments. This initial review of the modeling assessment revealed important model constraints and errors which should be addressed prior to the formulation of any definitive conclusions. These issues are especially relevant to simulations and projections for Reach 1 and 2 which include Portage Creek and the Kalamazoo River for 14 miles downstream of their confluence. These comments do not exhaustively address all relevant issues but certainly present issues which are troubling and very important. The summary statements made in the Executive Summary would be seriously altered by these prominent modeling problems. The conclusions relative to the proposed management alternatives are especially suspect. Similar modeling assesments using other model structures available in the peer reviewed literature could better demonstrate model reliability and would forecast important differences in anticipated system response to management alternatives. Proper modeling of an environmental site remains an important method of forecasting response to various management alternatives. However, the way in which this modeling effort was constrained and implemented invalidates many associated conclusions. It is recognized that this is a Draft Report and, therefore, it is hoped that many of these comments can be rigorously addressed prior to any important management decisions.

General Comments:

1. Bryant Pond is not modeled. This fact makes an assessment of management alternatives compared to a No Action Scenario dependent only on conjecture via the user's boundary assumptions and not appreciably on model kinetics. The user's assumptions in the report are not reasonably reflective of either a time-variable response or a steady-state response. Expectation of steady-state loads from Bryant Pond to the downstream system should approach background conditions and not a constant load reflective of today's observations. This No Action response would logically be due to burial and export due to erosion, resuspension, etc. These model kinetics are present in the model structure, yet they were inexplicably not applied to Bryant Pond. These expectations would rightfully minimize the long-term differences in the management alternatives and question the utility of the steady-state approach. This present feature of the model is quite unfortunate and makes its application for quantitative, mechanistic assessment of management alternatives on Bryant Pond impractical. The results of the model assessments can easily be influenced by arbitrary and inappropriate boundary assumptions. In fact, there are a number of examples within the assessment of management alternatives where the authors choose not to model anticipated responses, but instead choose to make unsubstantiated assumptions as model inputs. This is most evident in the treatment of Bryant Pond and the approaches to steady-state modeling. These management responses in Bryant Pond could have and should have been modeled, especially for the No Action Scenario.

2. The Kalamazoo River upstream of Portage Creek is also not modeled. This prevents an assessment of Morrow Pond where fish levels are more than twice those observed in Portage Creek. In addition, a <u>substantial conceptual error</u> is made when inputing this upstream load and flow into Reach 2. Upstream Kalamazoo River load and flow is input uniformly along the length of Reach 2 instead of appropriately at the head of Reach 2. This error has a significant impact on the modeling of Reach 2. This impact is especially evident when a rather basic engineering analysis is done of the NUS No Action Scenario. A mass balance of 126 ng/l coming in from Portage Creek at 120 m^3/min mixing with the upstream Kalamazoo River (13 ng/l at 1600 m^3/min) would indicate an initial concentration at the beginning of Reach 2 of about 20 ng/l. Field observations indicate that complete mixing would be accomplished within a relatively short distance of the confluence. Yet, NUS reports the average concentration "modeled" for Reach 2 to be 74 ng/l. This difference is not due to "other kinetics" but instead to the fact that the dominant Kalamazoo River upstream flow and load is uniformly distributed along the entire 23,000 meter length of Reach 2. In effect, this conceptual error means that NUS is "modeling" the Portage Creek "plume" with only gradual influence of the upstream River. This is a very noteworthy error which substantially overestimates the impact of Portage Creek on the Kalamazoo River within Reach 2 and on the associated fish responses.

PRELIMINARY

3. The ultimate criterion to judge management alternatives in the report is the projected level of PCBs in resident fish. NUS properly notes that representative BCFs can be derived from the available data and proceeds to calculate a few segment specific BCFs. Yet, when applying the model and the BCFs to evaluate the management alternatives NUS does not use the BCF that would likewise be calculated for Portage Creek based on available data. Instead, a maximum value observed in the Kalamazoo River is arbitrarily used. The application of the empirical BCFs to the problem should have been preceeded by a demonstration of the performance of this approach. This performance could be evaluated by comparing model predictions under no action to present spatial observations of fish levels. This approach is similar to what NUS did for the water and sediment compartment when attempting to demonstrate model calibration. This approach would demonstrate that other selected BCFs are appropriate both in Portage Creek and in the far downstream reach of the river. The present poor performance and inexact calibration of the fish PCB model would tend to overestimate the resulting PCB levels in Portage Creek fish. This is very apparent when the 1985 MDNR data indicates an average PCB level of 0.8 ppm in Portage Creek carp while the model would predict a value nearly ten times as high.

4. The approach by NUS to demonstrate model calibration/verification is highly unorthodox, incompletely documented, and not very convincing of model performance. A number of more specific comments could be made, but in general, the use of one year's worth of data to demonstrate calibration is not a robust method and the concept of dividing the year into two periods to demonstrate calibration and then verification is inappropriate and extends the utility of the data beyond reasonable limits. The documentation of the application of the steady-state model versus the time-variable model for calibration is very poor. Other, more established methods of demonstrating model peformance are available and applicable.

5. Throughout the development of the model the authors develop many complicating kinetics to represent a whole host of processes. Yet, during model application many of these terms are either "zeroed out" or are shown to have minimal influence. Since this model and its documentation is intended to be used as a management tool to project reasonable expectations of system response, it may be best to simplify the presentation, interpretation, and structure of the model and report by removing these terms.

6. The model used to evaluate management Scenarios is a steady-state model. This means that differences in response over time cannot be evaluated. This model restriction is quite unfortunate because the relative benefits of management scenarios typically require that the various responses be evaluated over time. In fact, for a substance like PCBs whose ultimate sources have been drastically curtailed and whose environmental presence will continue to be naturally reduced, the steady-state response for a No Action Scenario should indicate environmental levels approaching background conditions. The reason that NUS analysis does not indicate this expected response is that the "upstream areas" of Bryant and Morrow Pond are not modeled. These areas are artificially held at constant loads that do not permit representation of natural reductions in environmental levels. This

model restriction is especially perplexing since the model structure incorporates the process that are operable in these "upstream" areas yet the authors do not apply the model processes in these important areas. Because of this restriction the model projections of the No Action Scenario cannot be taken as an accurate representation of natural system recovery.

7. Many model inputs that conceptually are area or time averaged have input values which are biased and not representative of reasonable average values. This biased input is especially evident in the values input for segment specific sediment PCB levels. No attempt is made to calculate an appropiate area - weighted average value and sediment values within a stream reach is omitted in preference of values above the water level on the stream banks. This procedure is exacerbated by the MDNR sampling strategy which was focused on areas suspected of high PCBs instead of obtaining values representative of an entire area. The calculation of "point sediment loadings" and associated PCB concentrations also appear to be calculated is an unorthodox and biased fashion. Insufficient attention is paid to accurately discerning the difference in influence from diffuse sources of solids and various other sources of solids including resuspension. In addition, the PCB levels associated with these "point sediment loadings" is not reflective of solids from an entire drainage basin. In general, demonstration of model performance for simulating solids dynamics is insufficient and less rigorous than similar studies.

8. The March 1986 NUS report includes a number of selected summary statements that are not clearly supported and the absence of other conclusions that a reasonable modeling analysis would make evident. Due to omisions and errors highlighted above in General Comments 1 and 2 conclusions regarding model segments 1 and 2 cannot be considered reflective of actual expectations. Simulation of the No Action Scenario is especially constrained and not fairly representative of response expectations. Basic scientific insight regarding the field data is sometimes missing. For instance, the overall fish levels would not indicate a highly contaminated area, especially compared with past levels and other populated inland waters. The average concentration of PCBs in Portage Creek Carp of 0.8 ppm is conspicuosly not discussed or integrated in a fair representation of present or future risk. The authors recommend that further study be conducted before action be taken in the Kalamazoo River, yet recommend action in Portage Creek even though the most important area was not modeled and the fish levels are well below the study's target level. When Reach 2 is properly modeled the influence of Portage Creek on the Kalamazoo River will be substantially less and the incremental benefits of various management alternatives will be less dramatic. In fact, a time-variable model should logically be required to discern the different responses because over time these differences will become progressively less.

Specific Comments:

Comment Number	Page(s)	Paragraph(s)	Comment
1	ES1-ES4	all	Not clearly substantiated and transparently slanted. Model restrictions and errors noted in General Comments invalidate many of these conclusions. See comments below.
2	1-4	1,2	Model framework that does not include Bryant Pond is highly questionable and will not allow for reasonable projections of responses to actions in this area. See General Comment No. 1
3	1-6	3,4	Statement that model is limited to use as a screening tool for determining relative effectiveness of alternatives. If so, then model will not reliably predict actual steady-state concentrations and should not be used to determine whether specific alternatives will achieve the goal of 2 ppm in fish.
4	2-2	2	Averaging of sediment data is not appropriate. Since the methodology for the selection of sample station locations is not documented and does not appear to be designed for determining a representative areal distribution of PCBs in the sediments. Manipulation of the available sediment data is also inappropriate. The sediment data should serve only to indicate that PCBs are present in some of the sediments of these areas. The distribution is highly variable.
5	2-2	last	Percentages of data that exceed 50 ppm are not necessarily equivalent to percentages of total sediment in the area that contain PCBs in excess of 50 ppm. See comment 4.
6	2-9	4	See comment 4.
7	2-11	1,2	The trend analyses are inappropriate. See comment 4.

Comment Number	Pages	Paragraphs	Comment
8	2-11	3	See comment 7.
9	2-13	3	Drawing conclusions based on one sample is inappropriate. Most areas of the Kalamazoo River and Portage Creek are geometrically and hydraulically similar to this area. There are inconsistencies in the assumptions and assessments.
10	2-15	last	Listing quotes from previous reports is not very meaningful or appropriate. Hopefully, equal effort and discussion could be expended on an integrated evaluation.
11	2-18	5	Statement that representative averages cannot be easily determined is a good observation. Analyses, data summaries, and conclusions should be viewed under this constraint.
12	2-24,26,27, 31,32,33	Tables	1981 Portage Creek Carp data should have been included.
13	2-21	3	"Fat-Normalization" as applied is an unsubstantiated method. Support documentation should be provided to demonstrate the mechanistic validity of applying linear regression to discrete temporal and spatial data sets.
14	2-28	1	Speculative and unsubstantiated theory. Supporting literature should be documented. Literature indicates that many factors can influence percent fat. A stress environment is just one of these factors.
15	2-34	Last	Based on the analysis that Morrow Pond carp are at 2 ppm, it seems that this area should be included in the areas under consideration for remedial action.
16			Overall, the analysis and discussion of the fish data was well done. Conclusions regarding trend is questionable and should be discussed in light of observations in similar areas and concurrent regulatory actions.

Comment Number	Page(s)	Paragraph(s)	Comment
17	2-36,2-38	all	See comment 10.
18	2-38	7	Trend conclusion for PCBs in sediment is inappropriate. See comments 4 and 11. Sampling strategy was not formulated or implemented to support this sort of assessment.
19	2-39	6	See comment 9.
20	3-1	1	Selection of steady-state model is questionable. See General Comments 1 and 6.
21	3-1	last	Splitting a one year sample base into two data sets for "calibration/verification" is very inappropriate and is not a true verification of the model. See General Comment 4.
22	3-2	2	See Comment 3 with respect to the limitations of the model as a predictive tool.
23	3-2 - 3-8	all	The model presented has several complex kinetic terms that are negligible with respect to overall PCB transport in the Kalamazoo River. Since the model is designed as a management tool, these negligile and complex kinetic terms should be dropped. See General Comment 5.
24	3-12		See Comment 2 with respect to the division of the Kalamazoo River into reaches.
25	3-23 - 3-28		Lengthy discussion of kinetic terms that are negligible. See comment 23.
26	3-26	3	Point sediment loading rates. See General Comment No. 7.
27	3-27	Table	No support documentation has been presented for the resuspension activity of carp. The relative impact of this activity is speculation. Other approaches are feasible and worth investigation.

Comment Number	Page(s)	Paragraph(s)	Comment
28	3-28		The method of model calibration/ verification is highly unorthodox, poorly documented, and model performance is not convincingly demonstrated.
29	3-28 - 3-33		Model is driven by the boundary conditions that were assumed, not by the kinetics of the system. Therefore, good calibration is a given. The "verification" is not a verification in any scientific sense.
30	3-31, 3-32	Tables	The model results for reach 2 should be much lower. Extremely inappropriate to represent upstream Kalamazoo River as a point source distributed over a 14 mile reach (QsCp/L). Reach 2 results represent calculations of the Portage Creek "plume" and are not representative of actual conditions.
31	3-37 - 3-45		Extremely poor way to present model sensitivity. The figures are very difficult to interpret. The relative unimportance of a number of complicting terms is demonstrated.
32	3-47		This is a much more meaningful way to demonstrate sensitivity. However, the scale used should be a relative scale. What reach is this for?
33	3-49	1	The Portage Creek loading would not have the most impact if reach 2 were modeled correctly. See comment 30.
34	3-49	3	See comment 3 with respect to models limitation as a predictive tool.
35	3-54	Table	Reasons for not calculating the bioconcentration factor for Portage Creek are not documented. See General Comment No. 3. Calculated Portage Creek bioconcentration factor is 5,882.

Comment Number	Page(s)	Paragraph(s)	Comment
36	3-56	2	Why is 45 minutes/run a constraint ? Only about fifteen runs are required for application. Management Scenarios compared to a No Action alternative require a time-variable assessment. Time to response is a valid concept which impacts cost effectiveness and anticipated risks.
37	4-1		Overall, the review of the available remedial action alternatives was well done. The alternative to reimpound Bryant Pond should be included.
38	4-28, 5-7, 5-8		Documentation and calculations should be provided to support the assumption that the loading from Bryant Pond will not change over time in the No-Action SS model runs. The model is hence a "fixed" model under this assumption. The incremental reduction of loads from Bryant Pond in response to remedial actions are not documented and are arbitrary assumptions. Support documentation should be provided.
39	5-9	Table	For alternative B,C, and D, the upstream Kalamazoo River loads were decreased. This is extremely inappropriate since actions on Portage Creek will not influence upstream Kalamazoo River loads.
40	5-1-End		This entire section of the report is inaccurate and invalid based on the conceptual errors discussed in comments 2, 3, 20, 28, 29, 30, 35, and 38.
41	5-13	Table	Support documentation for the BCF selected for Reach 1 is not provided. Furthermore, estimates of PCB levels in Reach 1 fish using this BCF are approximately 10 times greater than observed.
42	5-15-End	All	Predicting actual fish concentrations eceeds the capabilities of the model. See comment 3.

Since the summary at the end of the report is the same as the exeutive summary, these comments apply to both.

Comment Number	Page(s)	Paragraph(s)	Comments
43	ES-All		This entire section may be invalid since the conclusions are based on a model with major conceptual errors.
44	ES-3	2-4	The recommendation is for "No-Action" for the Kalamazoo River and immediate major remedial action for Portage Creek. In light of the major conceptual errors in the model, this recommendation has not been demonstrated to be the most cost-effective or most reasonable.
45	ES-4	1	Support documentation is not provided anywhere in the report for the incremental impact of disturbances due to carp.
46	ES-4	2	Is the model any less reliable for predicting the effectiveness of reimpoundment than for other alternatives?
47	ES-5	All	Reimpoundment of Bryant Pond should have been considered.